CHALLENGING QUESTIONS ON SPACE

1 a On a sundial, the hour marks are not equally spaced. Why?
b On which wall of a building in the UK should you put a sundial? On which wall of a building in Australia should you put a sundial? Explain why.

2 Why is the Sun lower in the sky at midday in winter than in summer?

3 Do we always see the same face of the Moon? Explain why.

4 How long is a day on the Moon?

5 How long is a day on Uranus? (Hint: Uranus is not 'upright' but is tilted at right angles. Imagine sitting on its surface and orbiting the Sun - how long does it take from sunrise to sunset?)

6 a Name some constellations that never set in the sky over the UK.
b Name the brightest star that rises in the UK.

7 What do the Moon and constellations look like from Australia, compared to the UK?

8 a Why is Jupiter's moon, Io, yellow? What effects would this have on an astronaut visiting Io?
b Why is Jupiter's moon, Europa, white? What effects would this have on an astronaut visiting Europa?

9 What are the fastest and slowest ways to get to Saturn from the Earth?

10 Which planet has the most moons?

11 Compare and explain the sketches of the route to the Moon taken by Apollo and SMART-1. You will need to look at the images Apollo10 route to the Moon and SMART-1 route to the Moon.

12 The Earth is furthest from the Sun during the summer in the UK and closest during the UK winter. So why is it hotter in the UK in the summer?

CHALLENGING QUESTIONS ON SPACE/**ANSWERS**

1 a The apparent movement of the Sun when it is rising and setting is different from the apparent movement when it is overhead.
b UK: south wall, Australia: north wall. This is so the Sun shines onto the wall.

2 The Earth is tilted so the angle of the Sun to the Earth is different at different times of the year.

3 The Moon spins on its own axis at almost the same rate as it travels round the Earth, turning once every 27 days. This means we can only see about 58% of the surface of the Moon. The remainder was not seen until the Moon missions of the 1960s.

4 14 days.

5 Uranus is lying 'horizontally', so the 'day' length is the same as the year length of 84 Earth-years.

6 a Ursa Major (Great Bear, or Plough), Ursa Minor (Little Bear), Cassiopeia, and Draco (the dragon)
b Sirius is the brightest and the most southern star that we can see from Britain. Spica is almost as bright and slightly further north.

7 They would appear upside down. You will also see new constellations, that are not visible from the UK. The Moon would look the same.

8 a Io is yellow because there is a lot of sulphur on its surface. Astronauts must;
- beware of the volcanoes making the sulphur plumes,
- try to stop sulphur dust clogging up their equipment and covering their visors so they cannot see, and
- try to avoid breathing in the 'bad eggs' smell of hydrogen sulphide.

b Europa appears white because of the ice on its surface - there may also be an ocean underneath. An astronaut might want to take a canoe, or some snowshoes and some sunglasses for the glare.

9 The fastest way is to travel via Venus and Jupiter; the slowest is to try and go direct. New ion-propulsion engines might be quicker than ordinary chemical engines because they keep going faster and faster and can be on for much longer.

10 Saturn has the most moons, but Jupiter may win, (on the day) because both planets keep capturing new ones and losing little ones. If your answers disagree, try finding the dates the books were published and plot the number of moons versus the date to see the increase or decrease with time.

11 Apollo 10 was a manned mission and needed to reach the Moon quickly (in days). It used liquid hydrogen-and-oxygen-fuelled engines which give out a lot of power but only over a relatively short time. SMART-1 is testing a new technology, ion-propulsion. Ion engines work in a far more leisurely way pushing gently for months or even years, accelerating steadily. For long distances this is much quicker over time than chemical engines (which would run out of fuel) and will be used on future missions such as BepiColombo to Mercury. SMART-1 will take 15 months to reach the Moon. You can follow its progress at **www.sci.esa.int.**

12 The tilt of the Earth causes the seasons. The Earth is closer to the Sun in winter because of its elliptical orbit. This changes over long time periods causing long term changes to the weather. Closest approach is 147 km, furthest away is 152 km.